SHIP PRODUCTION COMMITTEE
FACILITIES AND ENVIRONMENTAL EFFECTS
SURFACE PREPARATION AND COATINGS
DESIGN/PRODUCTION INTEGRATION
HUMAN RESOURCE INNOVATION
MARINE INDUSTRY STANDARDS
WELDING
INDUSTRIAL ENGINEERING
EDUCATION AND TRAINING

August 1990
NSRP 0320

THE NATIONAL SHIPBUILDING RESEARCH PROGRAM

1990 Ship Production Symposium

Paper No. 2B-2: Financial Questions -- Industrial Engineering Answers

U.S. DEPARTMENT OF THE NAVY
CARDEROCK DIVISION,
NAVAL SURFACE WARFARE CENTER

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
AUG 1990	**N/A**	**-**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
The National Shipbuilding Research Program, 1990 Ship Production Symposium, Paper No. 2B-2: Financial Questions -- Industrial Engineering Answers	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Naval Surface Warfare Center CD Code 2230-Design Integration Tools Bldg 192, Room 128 9500 MacArthur Blvd, Bethesda, MD 20817-5700**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release, distribution unlimited

13. SUPPLEMENTARY NOTES

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			
unclassified	**unclassified**	**unclassified**	**SAR**	**9**	

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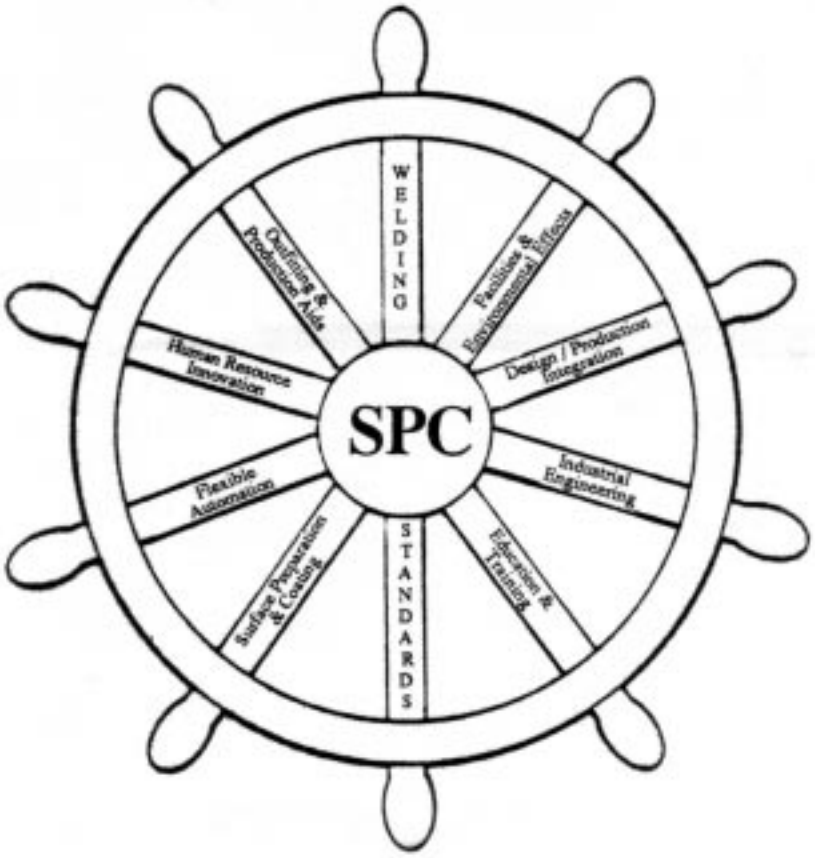

August 22-24, 1990
Pfister Hotel
Milwaukee, Wisconsin

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THE SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS

THE SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS
601 Pavonia Avenue, Jersey City, NJ 07306

Paper presented at the NSRP 1990 Ship Production Symposium,
Pfister Hotel, Milwaukee, Wisconsin, August 21-24.1990

Financial Questions-Industrial Engineering Answers

2B-2

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ABSTRACT

In quest of increased efficiency to make better use of financial resources, industry, both public and private sector, have often been turning to the industrial engineering community for help. And while there has been progress in measuring the efficiency of human resources and establishing work standards, similar efforts in the use of equipment have, in recent years, become of greater interest and will continue to do so in the coming *years.*

While tracking equipment utilization for a special study of a shop. process, or organization can be helpful, an ongoing program that is a part of routine management can more than pay for itself. Tracking equipment utilization can contribute to:

Workload planning
Evaluating equipment needs
Identifying bottlenecks
Identifying equipment with excessive down-time
Identifying capability related to new opportunities
Identifying needed equipment
Equipment replacement decisions

Good financial decisions in these areas require a knowledge of current and past equipment utilization. Without valid information, an important ingredient of the decision process is missing.

There are many techniques for obtaining equipment utilization information. There are also several factors affecting the cost and validity of the data. such as continuity, time to set-up, cost to implement, cost to maintain, accuracy, and objectivity of the data. The various techniques and factors outlined are discussed and evaluated.

INTRODUCTION

The cost of fixed assets are a common area *of* concern to both private and public industrial organizations in that they affect the relative competitive position of the organization's activity. While there is a national rationale for minimizing equipment costs--i.e.. our national needs exceed our resources--there is an even more visible rationale for maximizing the return of these costs at an individual shipyard. In an increasingly competitive environment, notwithstanding the certainty of decreasing defense budgets, it is important that every available cost control tool be used. The primary

means of reducing costs include maintenance and analysis of equipment utilization data.

There are basically five steps in the economic analysis function:

Problem Identification

Measure (collect data)

Analyze

Verify Problem

Solve Problem

Collecting equipment utilization data 18 simply the measurement function.

INDUSTRY USES OF EQUIPMENT UTILIZATION DATA

Equipment utilization information is used widely in industry as a valuable tool to manage operations, control costs, maximize the return on investments and prepare documentation to verify need and audit the effectiveness of previous acquisitions. Virtually every company has more rigorous criteria and tightened controls over capital expenditures in recent years. In the airline industry new procurements are justified based on equipment utilization data.

The interest in equipment utilization often arises from a need to maximize the return on investment capital by optimizing the utilization of existing equipment and avoiding unnecessary expenditures for new equipment. Airlines send their wide body landing gear cylinders to a vendor for rework. Purchasing larger, specialized equipment would have very low utilization due to the low volume of this type of work.

Until recently. the primary focus of industrial engineers has been to reduce direct labor costs. As a result, there has been a marked reduction in direct labor costs relative to equipment and material costs. (Faster more efficient machines replacing more than one of their older, inefficient counterparts reducing required manpower and excess material costs). Although these efforts are not going to be abandoned, industrial engineers are increasingly being directed to improve the utilization of productive equipment.

MANAGE OPERATIONS

Equipment utilization data can aide in the management of industrial operations.

A major airline routinely assesses the capacity of its machinery in the shop. The methodology evaluates capacity-related information for each sub-shop by engine type. Data for each sub-shop is plotted on a chart, graphically portraying the overall workload and also highlighting those machines approaching capacity. When additional workload 18 anticipated, the required machine hours are computed and added to the current utilization data. This will help determine if the current machine capacity is sufficient to handle the additional workload.

Accurate forecasts (short. intermediate. or long-range) of workload, capacity, capital requirements, and operational needs are not possible without knowing current capabilities.

When volume increases to near capacity, or when a new product is being considered, one of the first questions asked is, 'Can we produce the work with the existing equipment?'

An organization must be able to accurately assess its ability to take on a new workload prior to committing to it by evaluating equipment needs. If the new workload exceeds the maximum capacity of an expensive piece of equipment, or equipment with long lead times to acquire, the shops' ability to meet commitments can be jeopardized.

At the shipyard a newly identified mission will over extend the capacity of the 5-axis profiling machines used for propellers. The first thought was to purchase a new B-axis machine, this would entail a three year lead time from purchase request to operation and over six million dollars. Utilization data was gathered for large milling type machines in the shipyard. The data showed that the 5-axis machines have a high utilization with no idle time and some down time (maintenance). The data gathered from the machine shop showed there are several large milling machines with very little utilization. After investigating the physical attributes (table size, feeds and speeds) it was decided that work not requiring 5-axis machining could be shifted from the 5-axis machines to the older manual 3-axis milling machines. This would allow

the 5-axis machines to work more efficiently with an increased capacity, doing the type of work they are meant to do and also increase the machine utilization and productivity of the machine shop. The new mission has still identified the need for new machinery. Some of the required work that would have to be accomplished using the 5-axis machines would once again exceed their capacity and make their production less than efficient. This would adversely affect completion dates. The purchase of a 2-spindle, Q-axis machine is being considered. This additional work will be done with accelerated productivity. The end results being increased shipyard productivity, increased machine utilization, Increased machine efficiency, and the accomplishment of a new mission on schedule.

If existing equipment cannot functionally handle the new work and new equipment with greater capability is required, it is often more economical to sub-contract the work than to do it in-house.

Some equipment may stand idle, along with the operators, even though there is work to be done. This happens frequently where the normal flow of parts has been interrupted causing production bottlenecks. Period-to-period variances of utilization data can point this out as a first step in identifying a problem area.

Equipment utilization data can point out which equipment has excessive down-time and could lead to improved maintenance practices or replacement, if practical.

When the shipyard was awarded the aircraft carrier life extension program, the new workload required a machine capable of drilling 2-l/2 inch holes. The plan was to use a one-of-a-kind early generation numerical control machine to support the new workload. Utilization data showed the machine had excessive down-time. Examination of the maintenance records showed the machine was over 15 years old and it no longer had the physical ability to produce the required *work* on schedule. With the help of this information it was decided to purchase a replacement machine. The new machine easily handles the workload it an increased productivity level.

Preventive maintenance is generally most effective if it can be tied directly to **actual utilization,** as opposed to a specific period of time.

CONTROL COSTS

The economic environment of business has changed significantly over the past two decades. A business cannot survive unless it is cost- competitive. Many private firms with excess capacity and the necessary capability are competing with or replacing public sector functions.

Equipment utilization data will aid in making economical and logical source decisions.

If existing equipment does not have the capacity available to handle contemplated work, it is often more economical to farm the work out to other vendors. Performing an economic analysis can help decide whether to add capacity, run a third shift or work overtime. Very often, when workload increases, the best alternative to purchasing new equipment is to add a shift or to work overtime. If the added work is of short duration, it is seldom economical to buy new equipment. If the work is long-term, then equipment utilization data is valuable for conducting least-cost studies of the alternatives.

Costs can also be controlled by removing unneeded equipment by reducing space, maintenance and power requirements.

MAXIMIZE RETURN ON INVESTMENTS

Is replacing existing equipment an essential or operational requirement; if not, is there an economic justification?

Can current utilization be increased? Can productivity be increased? Can replacement be avoided? A major auto manufacturer developed a company-wide machine utilization program which has increased machine productivity. All of the remote plants use the same method to determine and measure equipment utilization. This measurement system is primarily applicable to mass production operations in which equipment utilization for many machines is nearing capacity and a slight increase in workload causes major production problems. At the same time, because many machines are near maximum capacity, any successful efforts to improve equipment

productivity generally result in the avoidance of capital expenditures.

EQUIPMENT UTILIZATION MEASUREMENT TECHNIQUES

The techniques used to collect equipment utilization data vary widely, depending on the following factors.

Continuity of data - For job shop operations, with large fluctuations in workload, a continuous method provides better data.

Time to set up - Some data collection techniques need long lead times to install due to the amount of resources, planning, and systems work required.

Cost to implement - Techniques involving computer systems and timers require higher expenditures to initiate.

Cost to maintain - On going, day-to-day costs to collect and manage equipment utilization data vary by technique. Automatic log-on/log-off and estimating systems are comparatively inexpensive.

Accuracy of data - Some applications, such as a cost benefit analyses, require very accurate data, while others need only ballpark figures.

Objectivity of data - Techniques which provide reproducible, verifiable data and which obtain data in the most objective manner will stand up better under third party audits.

Usefulness of data - Related to accuracy and objectivity, to be useful, the data must have credibility.

There are five primary measurement techniques for measuring equipment utilization.

Automatic log-on/log-off system - The automatic log-on, log-off system of data collection enables the equipment operator to log-on and start data collection at the start of a job then log- off and stop data collection when the job is completed. Log-on/log-off can be accomplished by direct entry to a computer via a punched card, keyboard, or bar code reader. The computer maintains utilization data as well as other job-related information. This information is available for various analyses. This technique provides accurate, objective data; however, it takes a long time to develop and install, and a large computer systems effort is required.

Sampling - Work sampling provides accurate information in proportion to the number of samples taken and, therefore, to the amount of labor required to collect it. Sampling also requires the observations to taken at a randomly selected time, and the particular 'labor state' being observed to be accurately defined and properly recorded. In equipment utilization the interest is in studying the 'machine' or 'equipment state' in the same manner as work sampling.

Spindle recorders - Spindle recorders can provide accurate data for some machines if the time measures more than just motor time. For example, a *sensor* attached to a spindle of a lathe, or the work-producing, moving part of the machine, will provide the time the spindle is active, but not setup, teardown, or miscellaneous times.

Operator logs - Logs provide fair data, at a relatively low cost, if the procedure to record the data is consistently applied.

Supervisor/Operator estimates - This method is used for filling in gaps in existing data, or for isolating problem areas or bottlenecks. Data tends to be overstated because memory tends to focus on the 'worst case.'

EVALUATION OF TECHNIQUES FOR OBTAINING EQUIPMENT UTILIZATION DATA

The particular equipment utilization technique adopted depends on a trade-off of the various factors affecting the cost, validity, and priority of need for the information. Figure 1 shows the relationship of the factors affecting all the data collection techniques by rating the important factors relevant to data collection from highly desirable to undesirable.. While the chart is based primarily upon the observations and experience of several industrial engineers, as opposed to any empirical data, it is the judgement of these professional engineers that the data presented is reasonably accurate for the management process of deciding which techniques to use. While automated log-on/log-off techniques can be extremely accurate,

there are problems associated with relating the usage to production: there is also a significant cost factor. Sampling is in the middle ground of cost and extremely accurate, if the program is run with integrity and a good data base is maintained.

EVALUATION OF EQUIPMENT UTILIZATION TECHNIQUES

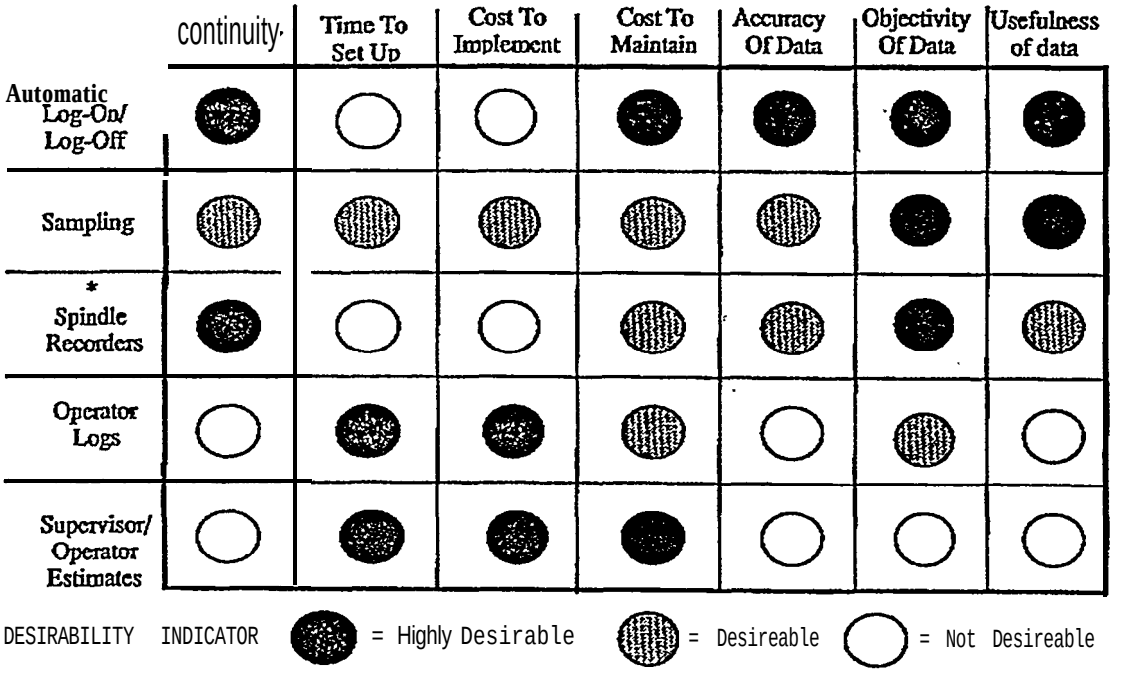

Figure.1

SUMMARY

Establishing a data base for maintaining equipment utilization data will significantly contribute to the confidence level in proposed procurements of plant property equipment, whether for replacement, enhancement, or upgrade. It will also allow the user to take advantage of lessons learned and to optimize the use of resources. An equipment utilization program should enable the user to avoid equipment replacement when possible and make smart procurement decisions when necessary.

ACKNOWLEDGEMENTS:

Walter Hemphill, Carl Olson and James Miller: Philadelphia Naval Shipyard, Code 380

Phillip Johnson, William McCune, John Crotty, Ira Grossman. and Chris Dolman; Booz. Allen, Hamilton Inc.

Wallace Bateman, John Wilson, and Joseph Gaudet; Science Management Corporation

Lynn Waite; American Management Systems Inc.